

(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF APPEALS AND INTERFERENCES

APPLICATION NO.: 10/730,398

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APPLICANT: BIELER ET AL.

GROUP ART UNIT: 1793

CONFIRMATION NO.: 6179

EXAMINER: SIKYIN IP

TITLE: METHODS FOR PRODUCING LEAD-FREE IN-SITU
COMPOSITE SOLDER ALLOYS

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MS Appeal Brief - Patents
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REPLY BRIEF FILED UNDER 37 C.F.R. § 41.41

In response to the Examiner's Answer mailed on September 2, 2008, please consider Appellants' Reply within two months of mailing as set forth herein, which supplements Appellants' Appeal Brief filed on June 16, 2008.

I. STATUS OF CLAIMS

Claims 20-62 are finally rejected. Claims 1-19 were cancelled. The claims on appeal are Claims 20-62.

II. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether Claims 20-24, 27-33, 36, 37, 39-45, 47-53, 55-59, and 62 are unpatentable under 35 U.S.C. § 103 over U.S. Patent No. 5,527,628 to Anderson et al., issued June 18, 1996 (herein "*Anderson*").
2. Whether Claims 25, 26, 38, 46, and 61 are unpatentable under 35 U.S.C. § 103 over *Anderson* in view of U.S. Patent No. 5,520,752 to Lucey, Jr. et al., issued May 28, 1996 (herein "*Lucey*").
3. Whether Claims 34, 35, 54, and 60 are unpatentable under 35 U.S.C. § 103 over *Anderson* in view of "*Issues Regarding Microstructural Coarsening Due to Aging of Eutectic Tin-Silver Solder*," by A.W. Gibson et al., Des Reliab. Solder Solder Interconnect, Proc. Symp., pp. 97-103 (1997) (herein "*Gibson*").

III. ARGUMENT

A. The Scope and Content of the Prior Art's Teachings Remain Deficient and Fail to Support a *Prima Facie* Case of Obviousness for Claims 20-62.

For all of the reasons set forth in Appellants' Appeal Brief and for the following reasons, the obviousness rejection remains unsupported by the scope and content of the cited art. The crux of the Examiner's rationale for the alleged obviousness of the claimed invention appears to be set forth on P. 8, ll. 7-10 of the Examiner's Answer. The Examiner states, the "[o]rdinary skill artisan has no need to modify the Cu-Ag-Sn alloy composition since instant claimed composition (components of eutectic or near-eutectic, appealed claim 20, for example) is overlapped by Anderson." As discussed below, there are two fundamental deficiencies in this analysis. First, *Anderson* does not set forth overlapping compositions with those claimed; the Examiner's assertion is factually incorrect. Second, the asserted rejection is an obviousness rejection, rather than an anticipation rejection. Thus consideration of all the evidence of record regarding the scope and content of the art from a skilled artisan's perspective is required. Here, the Examiner's apparent refusal to consider the evidence of record, or to interpret the prior art as a person of skill in the art would, is improper and fails to establish a *prima facie* obviousness rejection for any of appealed Claims 20-60.

1. The *Anderson* Patent Does Not Teach Overlapping Compositional Ranges and Instead Teaches Away From the Claimed Invention.

The Examiner is incorrect in asserting that the claimed intermetallic component ranges overlap with those set forth in *Anderson*. It appears that the Examiner liberally interprets *Anderson's* description of about 4.0 weight % Cu to encompass 4.4 wt. % Cu. “[T]he Pb-free solder consists essentially of about 3.5 to about 7.7 weight % Ag, about 1.0 to about 4.0 weight % Cu and the balance essentially Sn.” Emphasis added by Examiner's Answer at P. 8, ll. 1-9, citing *Anderson*, Col. 2, ll. 60-64. This interpretation of “about” is wholly unsupported by the teachings of *Anderson*.

The word “about” does not have a universal meaning in patent claims; instead its meaning when used in a numeric range depends on the technological facts of the particular case and the context in which it is used. *See Cohesive Technologies v. Waters Corp.*, 2008 U.S. App. LEXIS 21013*32-33 (Fed. Cir. Oct. 7 2008). In determining how far beyond the range the term “about” extends, one assesses the criticality of the numerical limitation to the invention; how the term “about” is used in the patent specification and the prosecution history, for example. *Cohesive Tech.*, 2008 U.S. App. LEXIS 21013*32-33 citing *Pall Corp. v. Micron Separations, Inc.*, 36 USPQ2d 1225, 1229 (Fed. Cir. 1995) (“It is appropriate

to consider the effects of varying that parameter, for the inventor's intended meaning is relevant.”).

In this context, *Anderson's* use of “about” in a numeric range is narrowly drawn and fails to describe or suggest compositional ranges which overlap with claimed composite solders having intermetallic components at greater than or equal to 10 volume %. *Anderson* posits its alleged ternary composition between those in the prior art by two distinguishing parameters 1) the Sn-Ag-Cu concentrations in the eutectic or near-eutectic solder compositions and 2) a narrow range of melting temperatures achieved by such eutectic or near-eutectic solder compositions. Notably, the recited composition of *Anderson* includes precise measurement to two significant figures (4.0 wt. %) and further describes in the specification these solder compositions consisting essentially of the recited Sn, Ag, and Cu elements, acknowledging such elements (and their respective concentrations) are restricted as being material to the purported invention. *Anderson* explicitly distinguishes its composition as being “well-removed from” a prior art ternary eutectic melting composition (90 wt.% Sn – 5 wt. % Ag – 5 wt. % Cu) having a reported melting temperature of 225°C.¹ Hence, *Anderson* avers

¹ *Anderson*, Col. 4, lines 36-50:

The measured melting temperature of 217°C for the previously unknown ternary eutectic solder of the invention is contrary to a minimum melting point of 225°C published heretofore for the Sn-Ag-Cu alloy system by E. Gebhardt and G. Petzow, Z. Metallkd., 50, no. 10, page 597, (1959). Applicants' measured ternary eutectic melting temperature of about 217°C was determined and verified by four (4) DTA analyses and with parallel analyses by other techniques, such as differential scanning calorimetry. The difference between Applicants' measured ternary eutectic melting temperature and that published in

that about 4.0 wt. % Cu is vastly different than 5 wt. % Cu in such a Sn-Ag-Cu solder.

Additionally, while *Anderson* states that varying amounts of Ag and Cu can be added to its purported eutectic composition to form intermetallic compounds, *Anderson* limits additions of Ag and Cu to the Sn matrix so that “the melting temperature range (liquid-solid ‘mushy’ zone) of the solder of the invention is extended no more than 15°C above the ternary eutectic melting temperature [217°C].”² Col. 5, lines 3-12 and Abstract.

In contrast, the claimed methods require a composite solder having an intermetallic component homogeneously distributed through a eutectic or near-eutectic matrix solder, where the intermetallic component is selected to have a density within 10% of the density of the matrix solder and is present at greater than or equal to 10 volume %. As noted in Appellants’ Appeal Brief, in an exemplary eutectic or near-eutectic Sn-Ag-Cu solder having 10 vol. % percent of a Cu₆Sn₅ intermetallic (in accordance with the claimed invention) a total copper concentration is over 4.4 wt. % and the composition has a melting temperature in excess of 310°C. A Cu concentration in excess of only 2.6 wt. % (where Ag is

the aforementioned article is that the previous published report is based on one measurement at a ternary composition (90 weight % Sn-5 weight % Ag-5 weight % Cu) well removed from the eutectic composition discovered by Applicants.

(Emphasis Added).

² See also, Col. 2, lines 1-8, stating that a solder having a ternary off-eutectic Sn-Cu-Ag solder (96 wt. % Ag – 3.5 wt. % Cu – 0.5 wt. Ag) has a solidus temperature of 227°C and liquidus of 260°C, “which would be considered too high by electronics manufacturers. Moreover, this solder exhibits a ‘mushy’ solid-liquid zone of 33°C. [sic] that is too great for electronic soldering.”

about 0.2 wt. %) provides a liquidus melting temperature of 310°C per the ternary phase diagram in *Moon* at Figure 14(a) at P. 1131. Where copper and silver are added and processed in the manner claimed to achieve a Sn-Ag-Cu solder composition having a melting temperature in excess of 310°C, such a melting temperature far exceeds the 217°C ± 15°C melting temperature ranges specified in *Anderson*. As such, when the range of copper set forth in *Anderson* is considered in context of the entirety of its teachings, it is clear that “about 4.0 weight % Cu” would not extend to 4.4 weight % Cu.³ Thus, the Examiner is incorrect in asserting that *Anderson* describes overlapping numeric compositional ranges with the claimed methods of forming composite solders, rather the *Anderson* reference remains deficient and inadequately supports the asserted obviousness rejections.

Moreover, as extensively discussed in the Appeal Brief, the present situation presents an unusual circumstance in that those of skill in the art recognize that the teachings of *Anderson* are flawed based on a calculation conversion error, so that the actual (*i.e.*, corrected) eutectic and/or near eutectic compositions of *Anderson* should be significantly lower concentrations of Ag and Cu, than those actually described therein.

³ Moreover, such compositions far exceed the prior art melting temperatures from which *Anderson* distinguishes itself (e.g., 260°C liquidus (Col. 2, ll. 5-8) and 225°C (Col. 4, l. 38)).

2. Neither the Scope and Content of the Prior Art, nor the Evidence Submitted by Appellants Has Been Properly Considered.

The Examiner's obviousness rejections are flawed because the Examiner has not adequately considered the scope and content of the prior art (particularly of the *Anderson* patent); the differences between the claimed invention and the prior art; or the evidence (including objective third party publications) submitted for consideration regarding the technical limitations of the prior art's teachings.

A proper obviousness analysis must consider both the scope and content of the prior art's teachings,⁴ including the fact that *Anderson* teaches away from the claimed invention, as well as recognizing limitations of any contribution of *Anderson* to the art based on objective third party evidence. Thus, a proper obviousness analysis mandates the Examiner's full consideration of the entirety of the prior art's teachings, as it pertains to the *Anderson* patent, as well as of the fact that *Anderson* itself teaches away from increasing concentrations of intermetallic compounds to those that would be required to meet the claimed invention.

⁴ As recently reiterated by the Federal Circuit, an obviousness rejection requires more than an anticipation rejection, because it requires further assessing the *Graham* factors to establish obviousness: (1) the scope and content of the prior art, (2) the level of ordinary skill in the art, (3) the differences between the claimed invention and the prior art, and (4) the so-called secondary considerations. See *Cohesive Tech.*, 2008 U.S. App. LEXIS 21013 at *23 (It bears noting that "[o]bviousness is not inherent anticipation.") citing *Graham v. John Deere Co.*, 383 U.S. 1 (1966).

Importantly, the Examiner has ignored evidence of record and failed to fully consider its impact on a skilled artisan's understanding of the scope and content of the prior art. Instead of considering the art from the perspective of a person of ordinary skill in the art, the Examiner has interjected his own interpretation of the art and ignored other salient information which contradicts the Examiner's interpretation of *Anderson's* teachings. The objective evidence of record includes published references authored by third parties (including admission of calculation errors in the *Anderson* patent by some of its inventors), as well as by 37 C.F.R. §1.132 Declaration of Dr. Bieler ("1.132 Declaration") in the Appeal Brief Evidence Appendix, each of which address the limited value of teachings of the *Anderson* patent to those of skill in the art, based on the extensive conversion errors contained therein. Specifically, this evidence establishes that while *Anderson* allegedly teaches a eutectic Sn-Ag-Cu composition, it is widely recognized that *Anderson* sets forth an erroneous eutectic Sn-Ag-Cu solder (93.6 Sn - 4.7 Ag - 1.7 Cu wt. %), based on a conversion error. *See 1.132 Declaration* at ¶¶ 5-7 and Moon et al., "Experimental and Thermodynamic Assessment of Sn-Ag-Cu Solder Alloys," J. of Elec. Materials, Vol. 29, No. 10, Pp. 1122-1136 (2002) (hereinafter "Moon").⁵ These errors were acknowledged by co-inventors of

⁵ Moon, in particular, states "Miller et al. [inventors of *Anderson*], using DTA, found a ternary eutectic at 217°C ... [with a] ... composition at 4.7 wt.% Ag, 1.7 wt.% Cu. A patent [*Anderson*] was issued based on this work... An error was made in the conversion from atomic to weight % conversion by Miller et al. The composition obtained from the initial estimate

Anderson in a subsequent article.⁶ Thus, those of skill in the art widely recognize that the purported eutectic compositions set forth in the *Anderson* patent are erroneous and should in fact have reflected lower concentrations of silver and copper. *See e.g.*, §1.132 Declaration at ¶¶ 5-7; *Moon*, at 1122-23. Thus, in failing to consider the totality of the scope and content of the prior art or the evidence of record, the Examiner has not properly supported the asserted obviousness rejections. From the proper perspective of a skilled artisan, the scope and content of the prior art in view of the evidence of record reveals the patentable and non-obvious differences between the claimed methods of forming *in-situ* composite solders having intermetallic compounds and the prior art.

As fully described in Appellants' Appeal Brief, neither the *Lucey* nor *Gibson* references' teachings account for the deficiencies of the *Anderson* reference and thus, whether independently or combined, fail to establish a *prima facie* case of obviousness. As such, a *prima facie* case of obviousness has not been established by any of the *Anderson*, *Lucey*, or *Gibson* references. Method Claims 20 through 62 are non-obvious over the prior art and reversal of the 35 U.S.C. § 103 obviousness rejections is requested.

⁶ was Sn – 3.25 wt.% Ag – 0.69 wt.% Cu.” (*Moon*, at pp. 1122, 1123) - submitted in Information Disclosure Statement filed on June 9, 2006.

⁶ *Anderson*, et al., “Microstructural Modifications and Properties of Sn-Ag-Cu Solder Joints Induced By Alloying,” *J. of Elec. Materials*, Vol. 31, No. 11 (2002), p. 1166, 1167 and footnote 6 (“*Anderson Article*”), submitted in Information Disclosure Statement filed on June 9, 2006.

IV. CONCLUSION

For all of the reasons set forth in Appellants' Appeal Brief and above, the present claims are patentable over the cited art. As discussed above, the Examiner has not met the burden necessary under applicable law to demonstrate that the claims are rendered obvious over the cited art. Appellants, therefore, respectfully ask this Honorable Board to reverse the final rejections of the claims on each ground and to indicate that all claims on appeal are allowable.

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Respectfully submitted,

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